CLAIMS

We claim:

1. An optical device comprising:

two face-to-face freestanding membranes each supported near a top surface on one of two bonded substrates for defining a resonant cavity between said two membranes;

each of said substrates having an entire bulk-portion opposite said cavity etched off as a bulk micro-machining opening extended from each of said membranes through a bottom surface of said substrates.

2. The optical device of claim 1 wherein:

said resonant cavity defining a distance of $N(\lambda/4)$ between said two freestanding membranes where N is a positive integer and λ is a wavelength of an optical signal.

3. The optical device of claim 1 wherein:

said two freestanding membranes having identical layer structure formed by a same set of manufacturing processes carried out on a single substrate wafer.

4. The optical device of claim 1 wherein:

said resonant cavity is surrounded by a cavity wall formed with two cavity spacers stacked and bonded for disposing said two freestanding membranes face-to-face across said resonant cavity.

5. The optical device of claim 4 wherein:

each of said two cavity spacers having an identical layer structure and a same thickness.

6. The optical device of claim 4 wherein:

each of said two cavity spacers having an identical layer structure formed by a same set of manufacturing processes on a single substrate wafer.

7. The optical device of claim 1 wherein:

each of said two freestanding membranes having multiple layers.

8. The optical device of claim 1 wherein:

each of said two freestanding membranes having odd number of layers.

9. The optical device of claim 1 wherein:

each of said two freestanding membranes having odd number of layers arranged with a symmetrical layer structure symmetrical to a central layer.

10. The optical device of claim 1 wherein:

each of said two freestanding membranes having an electrically conductive layer provided for controlling said membranes.

11. An optical device comprising:

a substrate having a through-hole; and

two face-to-face freestanding membranes disposed in said through-hole formed as membrane layers extended across said through hole and supported on said substrate for providing a resonant cavity between said two membranes.

12. The optical device of claim 11 wherein:

said resonant cavity defining a distance of $N(\lambda/4)$ between said two freestanding membranes where N is a positive integer and λ is a wavelength of an optical signal.

13. The optical device of claim 11 wherein:

said two freestanding membranes having identical layer structure formed by a same set of manufacturing processes carried out on a single substrate wafer.

14. The optical device of claim 11 wherein:

said resonant cavity is surrounded by a cavity wall formed with two cavity spacers stacked and bonded for disposing said two freestanding membranes face-to-face across said resonant cavity.

15. The optical device of claim 14 wherein:

each of said two cavity spacers having an identical layer structure and a same thickness.

16. The optical device of claim 14 wherein:

each of said two cavity spacers having an identical layer structure formed by a same set of manufacturing processes on a single substrate wafer.

17. The optical device of claim 11 wherein:

each of said two freestanding membranes having multiple layers.

18. The optical device of claim 11 wherein:

each of said two freestanding membranes having odd number of layers.

19. The optical device of claim 11 wherein:

each of said two freestanding membranes having odd number of layers arranged with a symmetrical layer structure symmetrical to a central layer.

20. The optical device of claim 11 wherein:

each of said two freestanding membranes having an electrically conductive layer provided for controlling said membranes.

21. A substrate comprising:

a through-hole in said substrate; and

a freestanding membrane disposed in said through-hole formed as a membrane layer extended across said through hole and supported on said substrate.

22. The substrate of claim 21 wherein:

said free standing membrane disposed near a top surface of said substrate; and

a chamber spacer disposed on said top surface surrounding said membrane.

23. The substrate of claim 21 wherein:

said free standing membrane disposed near a top surface of said substrate; and

a chamber spacer having a thickness of N(λ/8) disposed on said top surface surrounding said membrane where N is a positive integer and λ is a wavelength of an optical signal.

24. A method of forming an optical device on a substrate comprising:

a) forming a membrane layer on a top surface of said substrate; and

b) applying a bulk micro-machining process for etching off an entire bulk portion of said substrate below said membrane layer whereby said membrane layer becoming a freestanding membrane layer above said entire bulk portion.

25. The method of claim 24 wherein:

said step a) of forming a membrane layer further comprising a step of forming said membrane layer with a bulk-etch protection bottom layer on said top surface of said substrate.